CLAIMS

I claim:

1. A heat exchanger comprising:

a housing including an open end, a closed end, and a pair of spaced first fluid openings disposed adjacent the open end;

a cap secured to the housing over the open end, the cap including a central dividing wall which separates the cap into a pair of chambers, each chamber in fluid communication with one of a pair of spaced second fluid openings in the cap; and

a plurality of unitary heat exchange modules disposed within the housing in fluid communication with the first fluid openings and the second fluid openings, the modules grouped to define a pair of separate cells each aligned with a chamber, each module including a pair of opposed faces, at least one longitudinal throughbore located between and extending parallel to the faces and a plurality of slots extending across the faces opposite and perpendicular to the throughbore, the throughbore in fluid communication with the second fluid openings, and the slots in fluid communication with the first fluid openings, said slots defined by fins having an open toothed construction permitting fluid flow along and transverse to the slots.

2. The heat exchanger of claim 1 wherein the cells are separated by a partition wall extending downwardly from the open end.

3. The heat exchanger of claim 2 wherein the housing includes a bottom portion disposed below the partition wall and secured to the housing opposite the open end to form the closed end.

4. The heat exchanger of claim 3 wherein the partition wall includes a central tube extending upwardly along the length of the partition wall.

5. The heat exchanger of claim 4 wherein the bottom portion is secured to the housing by a bolt inserted through a hole in a bottom portion opposite the housing and into the central tube in the partition wall.

6. The heat exchanger of claim 5 wherein the central tube is positioned in alignment with a nut disposed in the cap in the dividing wall and the bolt is releasably engageable with the nut.

7. The heat exchanger of claim 5 wherein the bottom portion includes a stiffener disposed within the bottom portion opposite the housing to enhance the rigidity of the bottom portion.

8. The heat exchanger of claim 2 further comprising a seal disposed between the bottom portion and the housing.

9. The heat exchanger of claim 2 wherein the bottom portion is welded to the housing.

10. The heat exchanger of claim 1 wherein the cap is demountably secured to the housing.

11. The heat exchanger of claim 10 wherein the cap includes an outwardly extending flange adjacent the housing that has a plurality of bolt holes spaced around the flange which are alignable with a complementary set of bolt holes located on a peripheral flange extending around the open end of the housing.

12. The heat exchanger of claim 11 further comprising a number of bolts inserted through the aligned bores and apertures and secured therein by nuts threadably engaged with one end of each bolt.

13. The heat exchanger of claim 1 further comprising a gasket positioned between the cap and the housing.

14. The heat exchanger of claim 13 wherein the gasket includes a sealant applied to the gasket.

15. The heat exchanger of claim 1 wherein each module comprises an extrusion.

16. The heat exchanger as set forth in claim 15 wherein the extrusion is aluminum.

17. The heat exchanger of claim 3 wherein each module is secured within the housing by attachment between a pair of header plates secured over the open end of the housing and between the housing and the bottom portion.

18. The heat exchanger of claim 17 wherein the modules are secured to the header plates by welds.

19. The heat exchanger of claim 3 wherein a lower edge of the partition wall

defines a passage between the partition wall and the header plate adjacent the bottom portion to allow fluid communication between the cells and the opposed fluid openings.

20. The heat exchanger of claim 1 wherein the housing and the heat exchanger modules are made of aluminum and the cap is made of steel.

21. The heat exchanger of claim 20 wherein the cap is made of stainless steel.

22. A heat exchanger comprising:

a plurality of unitary tubular heat exchange modules of a generally rectangular cross section, each module having at least one longitudinal through bore between opposite outer face portions which face portions are joined by opposite edge faces;

the outer face portions along substantially the full length of the module having formed therein slots that extend perpendicular to the through bore between said edge faces, said slots defining narrow heat exchange fins, said fins having a toothed shape, the endmost fin at each end of the module terminating adjacent a neck that surrounds and defines an end opening to said throughbore;

said plurality of modules arranged with the face portion of adjacent modules in juxtaposition;

a header plate for each end of said plurality of modules, each header plate having a plurality of openings sized to receive the necks of the modules and to interconnect and hold the same in an assembly, each header plate supported on an endmost fin and closing the space defined by the tooth shaped fins between the necks of adjacent modules, and each header plate having a peripheral edge generally coincident with the outer periphery of the assembly;

a sealing material providing fluid tight seams between each header plate opening and the respective neck extending therethrough;

welds connecting each header plate to the assembly; and,

a tank having a continuous outer edge connected to the peripheral edge of each header plate along a fluid tight joint.

23. The heat exchanger as set forth in claim 22 comprising:

a housing extending between the header plates and at least partially enclosing the assembly;

a first fluid inlet for directing a first fluid into the housing and the slots formed in

the modules of the assembly;

an outlet for directing the first fluid from the housing and positioned with respect to said first fluid inlet to cause the first fluid to flow through the assembly in a direction along said slots and transverse thereto through the spaces defined by said tooth-shaped fins; and,

a second fluid inlet connection to one of said tanks for directing a second fluid through the longitudinal bores in said modules and into the other tank..

24. The heat exchanger as set forth in claim 23 wherein said housing comprises a walled enclosure including a pair of side walls and a pair of end walls, said heat exchanger further comprising:

a pair of module assemblies within the housing;

a partition wall separating the assemblies, said partition wall extending between opposite side walls and connected along an edge between the side walls to one of the header plates;

an open passage between an opposite partition wall edge and the other header plate providing a connection for said first fluid between said assemblies; and,

said inlet and outlet for said first fluid positioned in housing walls on opposite sides of said partition wall and adjacent said one header plate.

25. The heat exchanger as set forth in claim 24 comprising:

a separator plate dividing said one tank into an inlet chamber for said first fluid and an outlet chamber for said first fluid; and,

said first fluid inlet connection opening into said inlet chamber, and a first fluid outlet connection in said outlet chamber for directing the first fluid from the heat exchanger.

26. A heat exchanger comprising:

a plurality of unitary tubular heat exchange modules of a generally rectangular cross section, each module having at least one longitudinal through bore between opposite outer face portions which face portions are joined by opposite edge faces;

the outer face portions along substantially the full length of the module having formed therein slots that extend perpendicular to the through bore between said edge faces, said slots defining narrow heat exchange fins extending between unslotted opposite

module ends, each of said ends terminating in a shoulder adjacent a neck that surrounds and defines an end opening to said throughbore;

said plurality of modules arranged with the face portions of adjacent modules in juxtaposition;

a header plate for each end of said plurality of modules, each header plate having a plurality of openings sized to receive the necks of the modules and to interconnect and hold the same in an assembly, each header plate supported on the shoulders and closing the space between the necks of adjacent modules, and each header plate having a peripheral edge generally coincident with the outer periphery of the assembly;

a sealing material providing fluid tight seams between each header plate opening and the respective neck extending therethrough;

welds connecting each header plate to the assembly; and,

a tank having a continuous outer edge connected to the peripheral edge of each header plate along a fluid tight joint.

27. The heat exchanger as set forth in claim 26 wherein said header plate comprises a generally flat main body portion containing said openings, and a peripheral outer rim enclosing the plate body portion to form a sealant containment chamber; and,

said sealing material comprising a pourable sealant filling said chamber and covering said body portion.

28. The heat exchanger as set forth in claim 26 wherein said welds comprise spaced welds between the unslotted ends of the modules and a surface of the plate body opposite the containment chamber.

29. The heat exchanger as set for in claim 27 wherein the outer edge of said bank extends into said containment chamber and the sealant to form said fluid tight joint.

30. The heat exchanger as set forth in claim 29 comprising spaced tack welds along an interface between the rim of the containment chamber and the edge of the tank.

31. The heat exchanger as set forth in claim 26 wherein the slots define air flow passages through the assembly and each of said tanks includes a fluid transfer connection.